

# COBE

## Cosmic Background Explorer

### Mission Objective

The mission objectives of the Cosmic Background Explorer (COBE) are to: 1) investigate the beginnings of organization of matter into galaxies, voids and clusters of galaxies following the Big Bang; 2) examine departures from perfect uniformity that must have occurred shortly after the Big Bang, appearing as spectral irregularities and anisotropy in the microwave and far infrared cosmic background radiation; and 3) search for the accumulated light from the very first stars and galaxies. The COBE mission activities include a definitive exploration and study of the diffuse radiation of the Universe between the wavelengths of 1 micrometer and 9.6 millimeters. This band includes the 3 degree Kelvin cosmic background radiation, which is thought to be the residual radiation from the hot Big Bang which is presumed to have started the expansion of the Universe, and also includes the infrared region from 1 micrometer to 300 micrometers.

TYPE OF MISSION	PROGRAM OFFICE	PROJECT LEAD CENTER	MANAGEMENT APPROACH	S/C CONTRACTOR	I&T CONTRACTOR
ASTROPHYSICS	SPACE SCIENCE & APPLICATIONS	GSFC	IN-HOUSE	GSFC IN-HOUSE	GSFC IN-HOUSE

### Payload Description

The COBE payload and spacecraft was originally designed for a Shuttle launch and subsequently redesigned for launch by an Expendable Launch Vehicle (ELV). The redesigned COBE ELV payload consists of an instrument module (IM) which contains three instruments and their associated electronics, and a base module that provides the spacecraft operational subsystems. The instruments include a Differential Microwave Radiometer (DMR), a Far Infrared Absolute Spectrometer (FIRAS) and a Diffuse Infrared Background Experiment (DIRBE). A superfluid helium dewar, also mounted on the IM core structure, houses and cools the FIRAS and DIRBE instruments to 1.5 degrees Kelvin. The base module contains the power, communications and attitude control systems. The orientation of the spin axis is maintained anti-earth and at 94 degrees to the sun-earth line. The operational orbit is dawn-dusk sun-synchronous so that the sun is always to the side and thus is shielded from the instruments. With this orbit and spin-axis orientation, the instruments perform a complete scan of the celestial sphere every six months.

INSTRUMENT NAME	ACRONYM	PI AFFILIATION	PRINCIPAL INVESTIGATOR	I&T CONTRACTOR
DIFFERENTIAL MICROWAVE RADIOMETER	DMR	UCB	G. F. SMOOT	GSFC
DIFFUSE INFRARED BACKGROUND EXPERIMENT	DIRBE	GSFC	M. G. HAUSER	GSFC
FAR INFRARED ABSOLUTE SPECTROMETER	FIRAS	GSFC	J. C. MATHER	GSFC

Instrument Descriptions
The COBE Differential Microwave Radiometer (DMR), Data Point 570, is developed in-house by GSFC and built with contractor support. The DMR detects and maps anisotropies on an angular scale of 7 degrees and larger in the cosmic background radiation at three frequencies: 31.5, 53, and 90 GHz. These frequencies are selected for minimum interference from galactic synchrotron and dust emission and to avoid interference from terrestrial and satellite-borne transmitters. The DMR includes a total of six separate radiometers, one pair at each of the three frequencies to provide redundancy. If one of a pair of radiometers at a frequency fails, at least half of the expected data is still obtained by the companion radiometer.
The COBE Diffuse Infrared Background Experiment (DIRBE), Data Point 569, is designed, built, integrated and tested in-house at GSFC with contractors providing fabrication support. The instrument uses an unobscured off-axis Gregorian telescope with a primary aperture of 19 centimeters diameter and a square field-of-view approximately 1 degree on an edge. The combination of a well-designed front baffle tube with multiple field and pupil stops eliminates scattered and diffracted light from baffles and baffle edges. The multiple stops reduce the demand on baffle performance. A single baffle is thus effective over the entire wavelength range from 1 to 300 microns.
The COBE Far Infrared Absolute Spectrometer (FIRAS), Data Point 571, is a GSFC in-house effort designed to measure the cosmic background radiation in the range from $1 \times 10^6$ to $1 \times 10^8$ angstroms. The FIRAS is a cryogenically cooled, rapid scan interferometer spectrophotometer of the fully symmetrized Martin-Puplett configuration conceived specifically for this application. The instrument uses four large area bolometers as detectors and receives inputs from two Winston cone optical flux collectors, one open to space and the second coupled to a blackbody reference source.

Launch
11/18/89